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A SOCIAL NETWORK ANALYSIS OF THE CO-AUTHORSHIP NETWORK OF THE PACIFIC ASIA CONFERENCE ON INFORMATION SYSTEMS FROM 1993 TO 2008

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Abstract

Using bibliographic data extracted from an Endnote database, social network analysis techniques were used to generate and analyse a network of co-authors with the aim of developing an understanding of the research community that produces the research knowledge published by the Pacific Asia Conference on Information Systems (PACIS). The PACIS community was found to be a healthy small-world community that kept evolving in order to provide an environment that supports collaboration and sharing of ideas between researchers. It was also found that, unlike a similar analysis of the European Conference on Information Systems (ECIS), the Pacific Asian IS scene was not dominated by a couple of key researchers as quite a significant number of star performers were identified. In fact, with a number of popular researchers, the Pacific Asian IS community is very similar to the Australasian IS community for which a similar analysis was performed at the Australasian Conference on Information Systems (ACIS) level.

Keywords: social network analysis, Information Systems discipline, co-authorship, collaboration.

1 INTRODUCTION

Interaction between researchers is well known to be the essence of research practice. Researchers interact not only to communicate research activities but also to collaborate with each other to co-produce research and co-author research results (Melin & Persson 1996). Since collaboration has the potential to promote research activity, productivity and impact, it should be encouraged, supported and monitored. Although it has been argued that co-authorship is no more than a partial indicator of collaboration, Laudel (2002) found that a major part of collaboration is not acknowledged as co-authors. Several studies (for instance, Patel 1973) have shown that there is a positive correlation between collaboration and co-authorship. In fact, co-authorship is one of the most tangible and documented forms of research collaboration (Glänzel & Schubert 2004).

A co-authorship network is a social network consisting of a collection of researchers each of whom is connected to one or more other researchers if they have co-authored one or more papers. This is based on the reasonable assumption that researchers who co-author a paper are acquainted with each other, although there are many researchers who know each other quite well but have never written a paper together. Such a network can be represented as a set of nodes (or vertices) denoting co-authors joined by edges (or links) denoting research acquaintance.

Social Network Analysis (SNA) is a sociological approach for analysing patterns of relationships and interactions between social actors in order to discover underlying social structure such as: central nodes that act as hubs, leaders or gatekeepers; highly connected groups; and patterns of interactions between groups (Wasserman & Faust 1994). SNA has been used to study social interaction in a wide range of domains. Examples include: collaboration networks (Newman 2001a), directors of companies (Davis & Greve 1997; Davis, Yoo & Baker 2003), organisational behaviour (Borgatti & Foster 2003), inter-organisational relations (Stuart 1998), computer-mediated communications (Garton, Haythornthwaite & Wellman 1999), and many others.

In this study, we propose to use SNA to study the community of researchers who publish their papers in the Pacific Asia Conference on Information Systems (PACIS) in order to reveal interesting patterns and features within this academic community. With the help of SNA, we hope to develop an understanding of the research community that produces the research knowledge published by PACIS by answering the following- Is the network a random structure or does it display recognisable properties? Is the community highly clustered around a few high profile researchers or is influence spread among a number of researchers? Who are the influential members of this community? What are the weaknesses or strengths of this network?

2 RELATED WORK

The idea of studying research collaboration patterns using bibliographic data is not new as there is a substantial body of literature in Information Science dealing with co-authorship patterns (Crane 1972; Persson & Beckmann 1995; van Raan 1990). Using co-authorship networks to study collaboration patterns between researchers is also not a new idea since with the availability of large bibliographic databases, it is relatively easy to construct large social networks with high reliability. These networks are true social networks, in the sense that it is very likely that two authors who write a paper together are acquainted with each other (Newman & Park 2003).

Scientific collaboration networks were studied for three disciplines, namely: physics, biomedical research and computer science using bibliographic data from four databases for the period 1995-1999 (Newman 2001b). In all three networks, a giant component of researchers was found to exist in which there is only a short path of intermediate acquaintances between any two researchers, hence all networks studied displayed the “small world” property. Some differences found between the disciplines studied were: (1) on average, researchers from experimental disciplines have larger number of collaborators than those from theoretical disciplines (largest average number of collaborators found in high-energy physics), and (2) the degree of network clustering is much lower in biomedicine than in the other disciplines (indicating less social organization in biomedicine). A similar study was performed for the disciplines of mathematics and neuro-science using bibliographic records from an electronic database for the eight-year period from 1991 to 1998 (Barabási et al. 2002).

In a study of scientific collaboration in the field of management and organisational studies, a different approach was taken by combining an analysis of the reasons why authors collaborate and the consequences of such collaboration together with an analysis of the social network created through collaboration (Acedo et al. 2006). However, the analysis of the reasons why authors collaborate was mainly exploratory in nature as the study only explored factors that have already been highlighted in the literature. The field of SNA itself was subject to a study on collaboration networks and the most central scientists in the field were found to be Barry Wellman and Patrick Doreian (Otte & Rousseau 2002).

Research collaboration within the Information Systems discipline has also been studied as social network analysis has been performed for both the International Conference on Information Systems (ICIS) (Xu & Chau 2006) and the European Conference on Information Systems (ECIS) (Vidgen, Henneberg & Naudé 2007). Social network analysis of ICIS was conducted using bibliographic data for the period 1980 to 2005 available from the Association of Information Systems to study the social identity of the discipline (Xu & Chau 2006). Among other things, results showed that: (1) the community of international IS researchers is well connected and they frequently interact with each other, (2) there exists a giant component of well-connected and most productive authors, and (3) the network has evolved healthily over time with the addition of new members and the improved connection among members.

The ECIS analysis was performed using bibliographic data from an Endnote database available from the London School of Economics for the period 1993 to 2005 (Vidgen, Henneberg & Naudé 2007). Research contributions were separated into research papers and panels and two networks were generated and analysed. While the panel network displayed small world properties, unlike other collaboration networks, the co-authorship network displayed only a few “small world” properties and hence a lesser sense of social cohesion than would be expected.

The authors have also studied the collaboration network of the Australasian Conference on Information Systems (ACIS) (Cheong & Corbitt 2008). Using bibliographic data extracted from an Endnote database, social network analysis techniques were used to generate and analyse a network of co-authors with the aim of developing an understanding of the research community that produces the research knowledge published by ACIS. The ACIS community was found to be a healthy small-world community that kept evolving in order to provide an environment that supports collaboration and sharing of ideas between researchers. It was also found that, unlike a similar analysis of ECIS, the Australasian scene was not dominated by a couple of key researchers as quite a significant number of star performers were identified.

Although social network analysis of the Information System discipline has been performed at the international, European and Australasian levels, to the best of our knowledge, it has not been attempted for the Pacific Asian scene yet, hence the motivation for the present work.

3 METHODOLOGY

Social network analysis (SNA) has emerged as a key technique in the social and behavioural sciences as well as in other major disciplines (Wasserman & Faust 1994). The main focus of SNA is on the relationships among social entities (e.g. communications among members of a group) and it makes use of a variety of statistical and visual analyses to achieve this. Although, social networks were initially studied in the social sciences, such studies were restricted to rather small systems viewing these networks as static graphs consisting of nodes representing individuals and links representing various quantifiable social interactions. In contrast, recent approaches rooted in statistical physics focus more on large networks searching for universalities both in the topology of the network and in the dynamics governing its evolution (Barabási et al. 2002).

Recently, SNA has been increasingly used as a structured way to analyse the extent of informal relationships (among people, teams, departments, or even organisations) within various formally defined groups (Cross et al. 2001). SNA makes visible these otherwise invisible patterns of interaction, to identify important groups in order to facilitate effective collaboration (Cross, Borgatti & Parker 2003). Thus, SNA helps to identify and assess the health of strategically important networks in an organisation. In the context of this study, we are using SNA to gain an understanding of the nodes (co-authors) and relationships (those who wrote a paper together) in the co-authorship network. Clearly, there are many different metrics that can be used to assess such networks. At an aggregate level, we will analyse the network as a whole in order to identify important major groups or components within the community of researchers, and for the giant or core component we will use measures that can give an indication of the productivity of the network (i.e. density of the network), speed of communication within the network (diameter of the network), etc. At a lower level, we will analyse the nodes of the network using several measures of centrality to find out who the most popular and influential researchers are within the ACIS community.

4 DATA COLLECTION AND PROCESSING

The bibliometric data used in this study is based on bibliographic data available from PACIS[1]. The data included all conference research papers published by PACIS from 1993[2] to 2008. The bibliographic data available from the PACIS web site was copied to text files and manipulated in Excel spreadsheets to sequence the fields in the appropriate order and saved as tab-delimited text files for import by the Endnote bibliographic software to create an Endnote database. An Endnote database format was selected to store the data because of the flexibility offered for processing activities as well as export capabilities to a variety of formats for further processing.

Once the data was in the Endnote database, all the bibliographic records (1437 papers in all were analysed since the 4 Chinese papers presented in 2008 were excluded from the analysis) were examined one by one to detect and correct typographical errors as well as inconsistencies in authors' names. A certain element of familiarity with Western and Asian names was required and whenever there were doubts about the spelling of a name, the author's paper was downloaded from the PACIS site to verify the name.

When performing social network analysis, it is important that a unique identifier be assigned to an author and a simple and commonly used identifier is a combination of the surname and initials. Although the generation of such an identifier is straightforward in a number of situations, there were certain difficulties with the PACIS publications. Some authors of Western origin do not use their middle names consistently as sometimes they do not provide a middle name (or initial). Problems caused by authors of Asian origin (Chinese, Japanese, Vietnamese, Indian, etc) include: (1) inconsistent ordering of surnames as sometimes they are written first and sometimes they are written last (unlike Western culture, when an Asian surname is written first, no comma is used to separate it from the first and middle names and this makes it difficult to identify), and (2) inconsistent way of writing the first and middle names as sometimes they are merged together by concatenation, sometimes a hyphen is used to concatenate them and sometimes they are written separately. Another difficulty caused by authors of any origin was the inconsistent use of alias names as sometimes some authors used an alias while at other times they did not use such a name. Cleaning author names was a very involved and time consuming activity.

[1] http://www.pacis-net.org/

[2] The first PACIS conference was held in Taiwan in 1993.

Using the export capabilities of Endnote, the data in the Endnote database was exported as an XML file which was further processed by a custom-written Java to extract a list of co-authors. Since we are only interested in co-authored publications, all papers written by single authors were ignored. Another custom-written Java program was then used to convert this list of authors into a network file of the DL format which is readable by UCINet (Borgatti, Everett & Freeman 2002), the software used for most of the social network analysis in this study.

Apart from generating the DL file, the Java utility was programmed to output a list of authors sorted in alphabetical order which was visually inspected to discover further typographical errors and inconsistencies in authors' names. Any correction to authors' names was made in the Endnote database and all the processes required to generate DL and log files were repeated once again. Thus, data cleaning was an iterative activity as when discrepancies were discovered in the log file, the Endnote database was cleaned and processed again until the data was considered good enough to proceed with the analysis. Data cleaning consumed a very large part of the data processing activities. Once the co-authorship data was in UCINet's DL format, various statistical analyses were performed using UCINet at network and co-author levels. The results of these analyses are reported and discussed in the following sections. Visualisation of the co-authorship network (or parts of the network) was performed using Pajek (Batagelj & Mrvar 1998), another popular SNA software.

5 NETWORK ANALYSIS

Table 1 shows the evolution of the PACIS community during the period 1993 to 2008. The cumulative number of papers presented at the conference grew from 67 in 1993 to 1437 in 2008 while the cumulative number of co-authored papers grew from 35 to 1154 during that time frame. As of 2008, the percentage of co-authored papers represents 80% of the total number of papers.

The *size* of a social network is denoted by the number of actors or nodes (co-authors in this case) and it gives an indication of the likelihood of interaction between nodes; the bigger the network, the greater the likelihood of interaction between co-authors. However, the bigger the network, the more difficult it becomes for everyone to be connected with each other and when the network is not fully connected, it contains a number of sub-networks (called components) for which there are no paths between nodes from one sub-network to another sub-network. The number of co-authors in the PACIS network grew from 78 in 1993 to 1256 in 2009 while the number of co-authors in the *main component* (the largest sub-network in which there is a path from a co-author to any other co-author) grew from 4 in 1993 to 663 in 2008. As of 2008, the percentage of co-authors in the main component represents 33% of the total number of co-authors. It should be noted that the main component is not a fully-connected network (i.e. everyone is not connected to everyone). The degree of connectedness of a network (or sub-network) is given by the *density* measure, which is the percentage of the number of actual connections over the total number of possible connections. The density of the main component dropped from 25.0 % in 1993 to 0.23% in 2008.

Another interesting feature of a network is an indication of the amount of time for a communication to pass through the network. A commonly-used measure is the *diameter* of the network; the shorter the diameter, the faster the diffusion of communications. The diameter of a network is measured by the longest geodesic distance in the network with the geodesic distance being the shortest path (in terms of number of links or connections) between any two nodes. So far, the diameter of the network has grown to 8, slightly more than what would be expected from a "small-world" network. One of the main characteristics of a small-world is the so-called "Six Degrees of Separation" phenomenon in which it is claimed that everybody on the planet is separated by only six other people (Watts 1999).

The structure of the PACIS network of co-authors displays small world properties because co-authors are well-connected, and are close to each other, hence information and knowledge can be transferred effectively in the network.

Year	# Papers (cumulative)	# Co-authored papers	# Actors in co-authorship network	# Actors in main component	Density of main component	Diameter of main component

		(cumulative)				
1993	67	35	78	5	25.00	1
1995	168	85	198	12	8.33	3
1997	252	147	319	17	6.25	4
2000	338	215	461	17	6.25	4
2001	426	289	602	17	6.25	4
2002	529	374	755	34	3.39	3
2003	662	487	949	67	1.67	4
2004	884	680	1292	193	0.58	6
2005	1037	805	1472	355	0.34	6
2006	1157	915	1645	424	0.30	7
2007	1312	1043	1839	548	0.23	7
2008	1437	1154	2009	663	0.19	8

Table 1: Evolution of PACIS community (1993-2008)

A sociogram of the main component in 2008 (most current state of the network at the time of writing) is shown in Figure 1. We chose to represent the co-authorship network as a directed network i.e. directed links from the main author to his/her co-authors. The thickness of the links gives an indication of the number of co-authored papers between a main author and the particular co-author. A visual inspection of the sociogram shows that certain individuals like Wei KK (Kwok Kee Wei, Chinese University of Hong Kong) and Ke WL (Wei Ling Ke, Clarkson University, New York) have a large number of links to other individuals and some of their links are quite thick. Although these two individuals are very popular, they do not dominate the scene as there is quite a range of other well-connected individuals visible on the sociogram. In order to confirm the popularity of Wei KK and Ke WL as well as identify other popular individuals, a more objective analysis is required at individual level (ego analysis). A more detailed analysis of popular individuals follows in the next section.

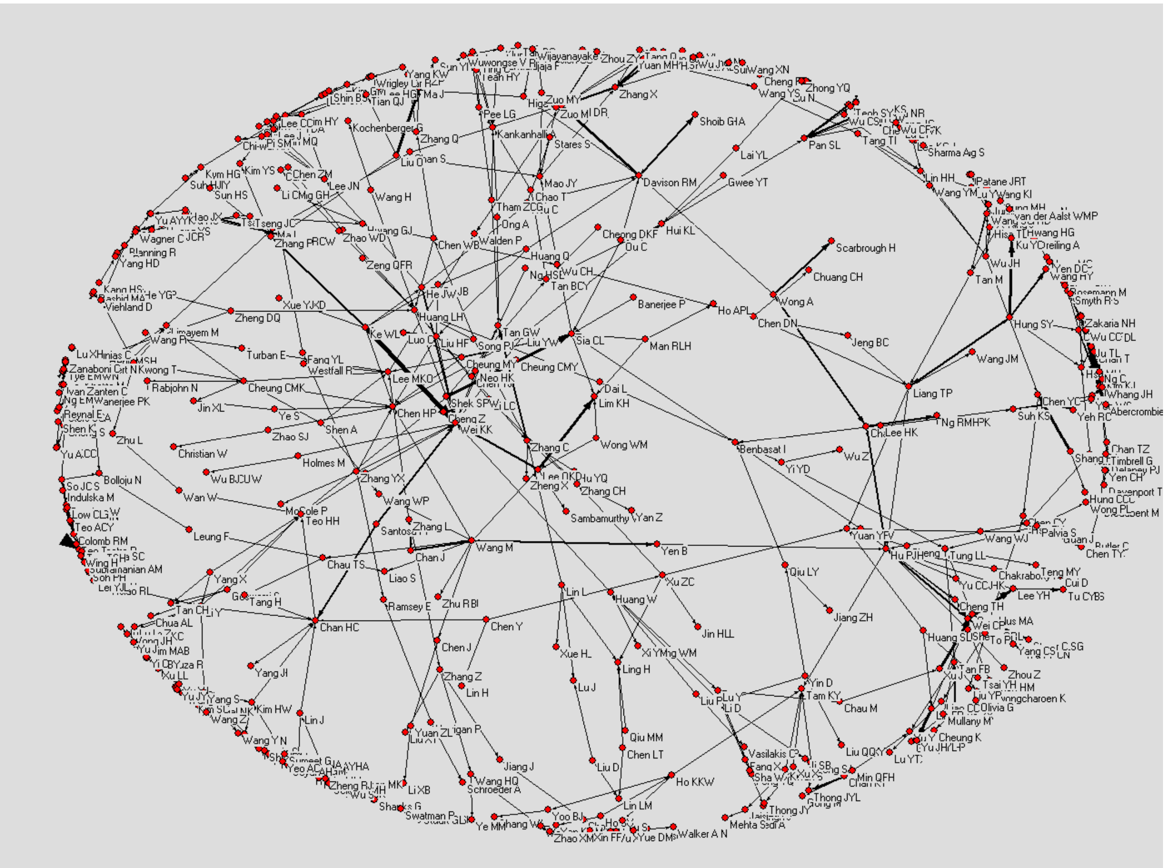

Figure 1: Main component sub-network

6 EGO ANALYSIS

After having analysed the characteristics of the PACIS network as an entity, we now analyse it in terms of the individual actors or "egos" that make up the nodes of the network. More specifically, co-authors are analysed in terms of their *centrality* in the PACIS network. The idea of centrality of individuals was one of the earliest used by social network analysts and the origins of this idea can be found in the sociometric concept of the *star* i.e. the most popular person or the person at the centre of attention (Scott 2007). Thus, a central actor is one at the centre of a number of connections i.e. an actor with a large number of direct links with other actors.

Centrality is measured by the *degree* of the various nodes in the network, with degree representing the number of other nodes to which a node is adjacent. This measure of centrality is known as *local centrality* since indirect connections to the particular node are ignored. Thus, the notion of centrality has been extended to *global centrality* (Freeman 1979) to include the distant connections of the nodes. This is measured by the *closeness* of the nodes to other nodes expressed in terms of the distances among the various nodes. *Betweenness* (Freeman 1979) is another centrality measure which measures the extent to which a particular node lies between the various other nodes of the network. A node of relatively low degree may play an important intermediary node (e.g. broker, gatekeeper, etc) and hence be a central node in the network. *Eigenvector* (Bonacich 1972) is another measure of centrality proposed based on the belief that the centrality of a particular node cannot be assessed in isolation from the centrality of all the other nodes to which it is connected. Centrality scores are assigned to nodes based on the principle that connections to high-score nodes contribute more to the score of the particular node than connections to low-score nodes.

The term *structural hole* was coined by Burt (1992) to refer to some important aspects of positional advantage (or disadvantage) of actors in a network. He developed a number of measures to explain how and why the ways actors are connected affect their constraints and opportunities and hence their behaviour.

Table 2 shows the top 30 actors ranked on the centrality measures previously discussed, namely: (1) degree, (2) betweeness, (3) closeness, (4) eigenvector (5) and structural holes.

1a. Out Degree											
1	Ke WL	15	9	Liang TP	10	17	Blanning R	6	25	Seyal AH	6
2	Lin FR	14	10	Wei CP	10	18	Chang SI	6	26	Shang RA	6
3	Hung SY	13	11	Lee YH	9	19	Chau PYK	6	27	Zhang X	6
4	Sedera D	13	12	Chen YC	8	20	Cheung CMK	6	28	Ahmad MN	5
5	Wang M	13	13	Srivastava SC	8	21	Lee HG	6	29	Burn JM	5
6	Vogel DR	11	14	Wu JH	8	22	Li Y	6	30	Harrigan P	5
7	Davison RM	10	15	Hsiao RL	7	23	Liu O	6			
8	Hu PJH	10	16	Lee OKD	7	24	Rahim MM	6			
1b. In Degree											
1	Wei KK	18	9	Sia CL	8	17	Zhang C	6	25	Lin HH	5
2	Gable GG	14	10	Teo TSH	8	18	Xu YJ	6	26	Tam KY	5
3	Huang LH	11	11	Wei CP	7	19	Lim KH	6	27	Yuan YF	5
4	Pan SL	10	12	Chan HC	7	20	Lee MKO	5	28	Liang TP	4
5	Vogel DR	9	13	Kankanhalli A	7	21	Zhang CH	5	29	Chen YC	4
6	Hu PJH	9	14	Tan GW	7	22	Chan T	5	30	Chau PYK	4
7	Quaddus MA	9	15	Teo HH	7	23	Colomb RM	5			
8	Chen HP	9	16	Davison RM	6	24	Kwok RCW	5			
2. Betweenness											
1	Hu PJH	33	9	Yuan YF	15	17	Lu YW	11	25	Cheung CMK	8
2	Liang TP	32	10	Xu ZC	15	18	Teo HH	10	26	Shek SPW	8
3	Wei KK	26	11	Chen HP	15	19	Lin HH	10	27	Gable GG	8
4	Hung SY	23	12	Sia CL	13	20	Chen Y	9	28	Tam KY	8
5	Wang M	23	13	Huang LH	13	21	Yang S	9	29	Wong A	7

6	Yen B	19	14	Davison RM	13	22	Lee OKD	9	30	Zhang L	7
7	Chan HC	17	15	Ku YC	11	23	Hui KL	8			
8	Li Y	15	16	Chang SI	11	24	Chau PYK	8			
3. Closeness											
1	Wei KK	17	9	Yen B	16	17	Lim KH	16	25	Shek SPW	15
2	Lee OKD	17	10	Hu PJH	16	18	Cheung MY	16	26	Huang Q	15
3	Wang M	17	11	Chan HC	16	19	Liang TP	16	27	Chen Y	15
4	Chen HP	17	12	Santosa PI	16	20	Liu X	16	28	Hsu C	15
5	Liu HF	17	13	Sia CL	16	21	He JW	16	29	Xu ZC	15
6	Ke WL	16	14	Huang LH	16	22	Tan GW	16	30	Huang W	15
7	Liu YW	16	15	Teo HH	16	23	Cheung CMK	15			
8	Zhang YX	16	16	Davison RM	16	24	Ou C	15			
4. Eigenvector											
1	Wei KK	63	9	Lee OKD	23	17	Santosa PI	15	25	Lee MKO	10
2	Ke WL	45	10	Liu YW	22	18	Holmes M	15	26	Zhang P	10
3	Chen HP	41	11	Tan GW	22	19	Zhang C	14	27	Teo HH	10
4	Liu HF	37	12	Gu JB	19	20	Huang Q	14	28	Chen WB	10
5	Huang LH	34	13	Huang W	18	21	Sia CL	12	29	Chen TJ	10
6	Wang M	26	14	Cheung CMK	17	22	Song PJ	12	30	Chan HC	10
7	He JW	25	15	Neo HK	17	23	Cheung MY	11			
8	Zhang YX	24	16	Liu X	15	24	Davison RM	11			
5. Structural Holes											
1	Vogel DR	16	9	Liang TP	12	17	Zhang C	9	25	Burn JM	7
2	Hu PJH	15	10	Pan SL	10	18	Cheung CMK	8	26	Chen YC	7
3	Huang LH	14	11	Lee HG	10	19	Li Y	8	27	Hsiao RL	7
4	Wang M	13	12	Sia CL	10	20	Ke WL	8	28	Huang W	7
5	Wei KK	12	13	Hung SY	9	21	Wu JH	8	29	Kym HG	7
6	Davison RM	12	14	Quaddus MA	9	22	Lee MKO	8	30	Mao JY	7
7	Lin FR	12	15	Chen HP	9	23	Wei CP	8			
8	Gable GG	12	16	Chan HC	9	24	Lee YH	8			

Table 2: Centrality measures of actors in main component

Since we chose to represent our co-authorship network as a directed network (we assume that the author selected the co-author for writing the paper), a centrality degree analysis yielded two scores: *out degree* (number of connections sent out i.e. as main author) and *in degree* (number of connections received i.e. as co-author). The first section of Table 2 shows the ranking of the top 30 individuals on the out degree score while the second section of the table ranks individuals by the in degree score. The top scorers in terms of out degree (main author) are Ke WL (Wei Ling Ke, Clarkson University, New York) and Lin FR (Fu Ren Lin, National Tsing Hua University, Taiwan) closely followed by Hung SY (Shin Yuan Hung, National Chung Cheng University, Taiwan). The individuals with high out degree scores can be thought of as having high influence in the network while those with high in degree scores as prestigious or popular individuals. The most prestigious individuals (as determined by their in degree scores) are Wei KK (Kwok Kee Wei) and Gable GG (Guy G Gable, Queensland University of Technology, Australia).

In regards to betweeness centrality, the top individuals are: Hu PJH (Paul Jen Hua Hu, University of Utah) followed by Liang TP (Ting Peng Liang, National Sun Yat-Sen University, Taiwan). Thus, Hu PJH and Liang TP can be viewed as leaders in the PACIS network since being on the shortest paths between other individuals they are able to control the flow of information in the network. In terms of closeness centrality, the scores of the 30 top individuals were very close with the leaders being Wei KK (Kwok Kee Wei) and Lee OKD (One Ki Daniel Lee, University of Massachusetts). Since closeness centrality measures the distance of an individual to all others in the network, the closer an individual is to others, the more favoured that individual is. Individuals with high closeness scores are likely to receive information more quickly than others as there are fewer intermediaries between them. Wei KK (Kwok Kee Wei) is by far the leading individual when the eigenvector centrality criterion is used. This means that he is connected to many other individuals who are well connected and thus is most likely to receive new ideas.

Structural holes was measured in terms of *Effective size of the network* i.e. the number of connections an individual has, minus the average number of connections that each individual has to other individuals. Vogel DR (Doug R Vogel, University of Hong Kong) followed by Hu PJH (Paul Jen Hua Hu) and Huang LH (Li Hua Huang, Fudan University, China) led on this criterion suggesting that they have more opportunities to act as brokers or coordinators. From the ego analysis, it can be seen then that, unlike the ECIS community, influence in PACIS is not limited to a few individuals (Vidgen, Henneberg & Naudé 2007). In fact, with a range of popular researchers, the PACIS network is very similar to the ACIS network (Cheong & Corbitt 2008).

7 VISUAL ANALYSIS

The top-ranking 30 actors for each centrality criteria mentioned in Table 2 were merged and an ego network (sub-network) made up of only these actors and their collaborators extracted from the main component sub-network in an attempt to visually identify any leading individuals. The resulting network is shown in Figure 2. From Figure 2, it can be seen that Wei KK (Kwok Kee Wei, Chinese University of Hong Kong) and Ke WL (Wei Ling Ke, Clarkson University, New York) are significant individuals. It can also be seen that there are other popular individuals, such as (limited to a few names in alphabetical order as the list can be quite long): Gable GG (Guy G Gable, Queensland University of Technology, Australia), Hu PJH (Paul Jen Hua Hu, University of Utah), Huang LH (Li Hua Huang, Fudan University, China), Lee OKD (One Ki Daniel Lee, University of Massachusetts) , Liang TP (Ting Peng Liang, National Sun Yat-Sen University, Taiwan), Lin FR (Fu Ren Lin, National Tsing Hua University, Taiwan), Vogel DR (Doug R Vogel, University of Hong Kong). Figure 2 further reinforces the previous finding (from the ego analysis) that there are quite a number of key researchers in the PACIS community.

8 DISCUSSION

The key findings of this study of the community of PACIS researchers are: (1) the total number of papers presented at the conference has been constantly growing since the establishment of the conference in 1993, (2) currently the percentage of co-authored papers represents 80% of the total number of papers, (3) the network contains a significantly large main component which includes 33% (663 individuals) of the total number of co-authors, (4) the main component exhibits small-world characteristics (nodes that are well-connected and close to each other), (5) although Wei KK (Kwok Kee Wei) and Ke WL (Wei Ling Ke) seem to be very popular individuals, they are closely followed by a number of other popular individuals.

The positive evolution of the main component of the PACIS network coupled with the presence of a number of key individuals (rather than a few) are evidence of the healthy status of the PACIS community. They are proof of the ability of the community to attract new members over the years and to produce new generations of star researchers. It is worth noting that although star researchers play an important role in the PACIS network, other researchers are also important as without them is no PACIS community.

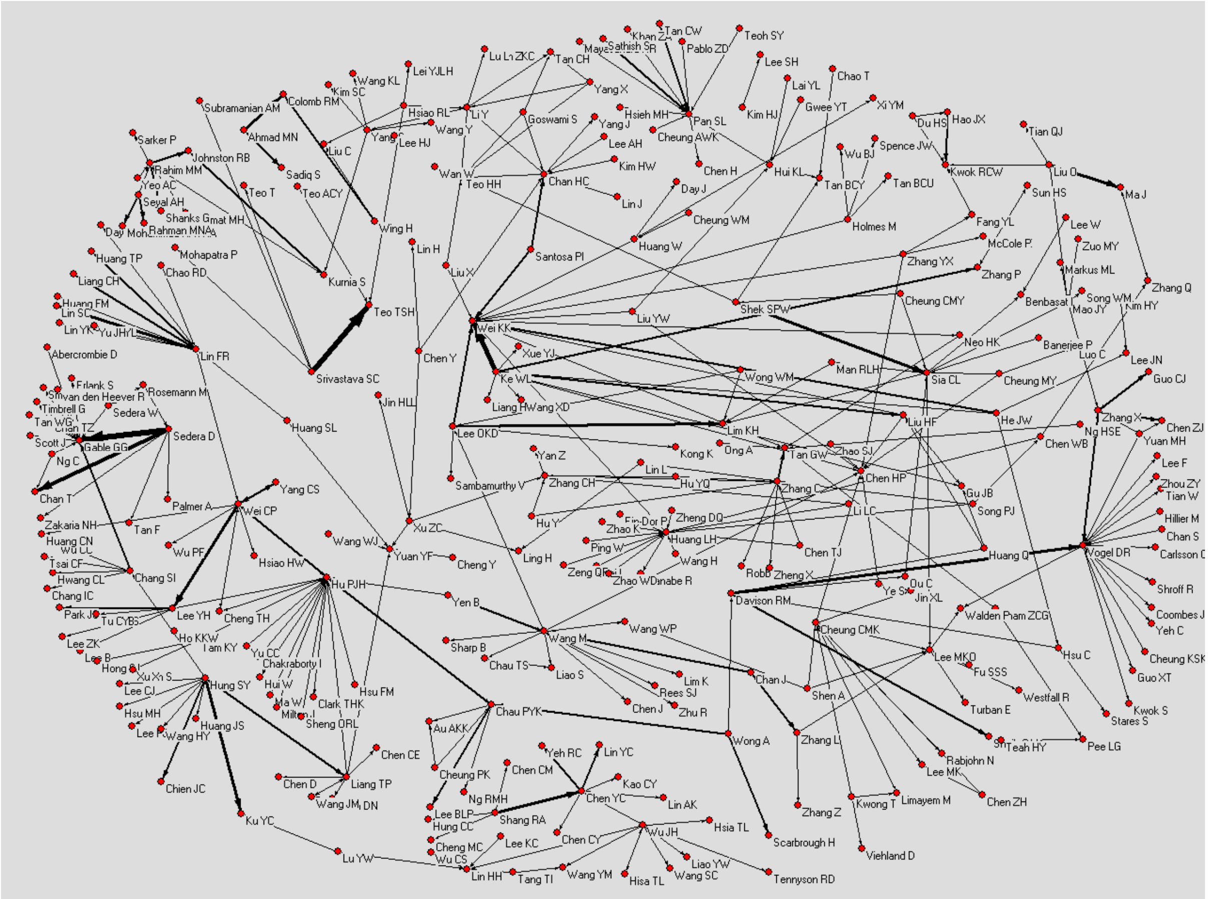

Figure 2: Main actors sub-network

The existence of a number of key researchers in the PACIS community provides several advantages. Firstly, it ensures the diversity of research within the community as a large number of star researchers would decrease the likelihood of performing similar research. Secondly, the PACIS community is resilient since removing a few key persons from the community (e.g. retirement, etc) will not cause it to fall apart as other key persons will ensure its continued existence. Thirdly, succession planning is a smooth and effective process as the large number of current generation star researchers train their doctoral students and junior collaborators to form a large pool of researchers from which new stars will emerge to lead the community in the future.

The structural properties of the PACIS network also indicate the existence of some potential problems with the community. Since the diameter of the network is slightly wider than desirable (eight instead of six), it is possible that information might not travel quickly enough for effective collaboration. However, the diameter of the PACIS network is still better than the diameter of 31 for the ECIS network (Vidgen, Henneberg & Naudé 2007). In fact, with a diameter of eight, the PACIS network is slightly better than ACIS which has a diameter nine (Cheong & Corbitt 2008). Although the presence of many key researchers guarantees free and open debate which is the lifeblood of academia, the uptake of new ideas might meet with more opposition (e.g. political resistance, resistance to change, etc) because there are more people to convince and hence greater likelihood of disagreements.

9 CONCLUSION

In this paper, we used SNA to study the interactions between co-authors of research papers presented at PACIS. SNA provides techniques to analyse the structure of a network as an entity as well as with techniques to analyse individual nodes (egos) and their place in the network. Using SNA metrics and visualisation techniques we were able to reveal structural characteristics of the PACIS co-authors community and identify influential members of this community. The PACIS community was found to be a healthy small-world community that kept evolving in order to provide an environment that supports collaboration and sharing of ideas between researchers. It was also found that unlike Europe, the Pacific Asian scene was not dominated by a couple of key researchers as quite a number of such individuals were identified. In fact, with a number of popular researchers, the Pacific Asian is very similar to the Australasian scene (Cheong & Corbitt 2008). However, the analysis has also identified a number of other key components of the social network which are not reported in this paper. These components, whilst not as large as the one reported above, do include a rich social network which is almost separate in connectedness. In addition, there is certainly evidence of *guanxi* connections in each of the components and that will be the focus of another paper.

Future work that could be undertaken to provide a better understanding of the PACIS community includes: (1) identification of the various groups that exist in the network and their research topics (using keyword analysis), and (2) incorporating institutional information in the analysis. Since most researchers publish in more than one conference or journal, the analysis of bibliographical data from PACIS cannot give a complete picture of the Pacific Asian IS authorship patterns. Thus, for a more complete coverage of the IS discipline in Pacific Asia, the boundary of the network should be extended to include other IS-related conferences and journals.

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